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XRPX Acc No: N95-260614

Solar battery circuit for household appliances - has solar battery which uses its power output to drive motor of fan

Patent Assignee: KYOCERA CORP (KYOC)
Number of Countries: 001 Number of Patents: 001
Patent Family:

Patent No	Kind	Date	Applicat No	Kind	Date	Week	
JP 7240532	A	19950912	JP 9430297	A	19940228	199545	B

Priority Applications (No Type Date): JP 9430297 A 19940228
Patent Details:

Patent No	Kind	Lan	Pg	Main IPC	Filing Notes
JP 7240532	A		5	H01L-031/042	

Abstract (Basic): JP 7240532 A

The circuit has a solar battery (1) and a motor (3) connected in series with an adverse-current prevention diode (2). This motor drives a fan (4) to prevent the temperature rise of the solar battery.

Meanwhile, the solar battery provides the power which can be used to operate the motor while supplying a load (H) and a storage battery (B).

ADVANTAGE - Provides optimum and automatic forced cooling, provides simple composition and operates according to sunlight intensity.

(19)日本国特許庁（ＪＰ）　(12) 公開特許公報(A)　(11)特許出願公開番号

特開平7－240532

(43)公開日　平成７年(1995)９月12日

(51)Int.Cl.[6]	識別記号	庁内整理番号	ＦＩ	技術表示箇所
Ｈ０１Ｌ　31/042				
31/04				
		7376－4M	Ｈ０１Ｌ　31/ 04	R
		7376－4M		K

審査請求　未請求　請求項の数１　ＯＬ　（全　５　頁）

(21)出願番号　特願平6－30297

(22)出願日　平成６年(1994)２月28日

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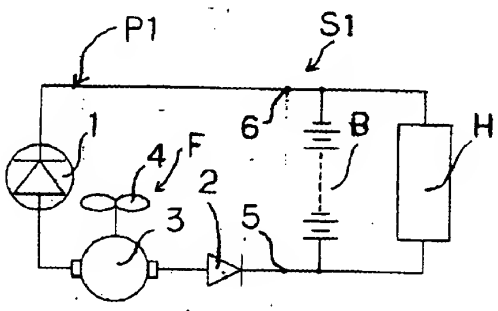
(54)【発明の名称】　太陽電池装置

(57)【要約】

【目的】　きわめて簡便な構成で、かつ太陽光エネルギーの有効活用をしながら、常に太陽電池の温度上昇を防止するように強制冷却が可能な優れた太陽電池装置を提供すること。

【構成】　太陽電池１の出力回路と、太陽電池１の温度上昇を防止する冷却手段の作動回路３とを、逆流防止ダイオード２を介して直列接続して成り、かつ太陽電池１の出力でもって作動回路３を動作せしめ、冷却手段を動作させるようにした。



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【特許請求の範囲】

【請求項１】太陽電池の出力回路と、該太陽電池の温度上昇を防止する冷却手段の作動回路とを、逆流防止ダイオードを介して直列接続し、前記太陽電池の出力でもって前記作動回路を動作せしめるように成した太陽電池装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明はファン、バルブ等の作動回路を用いて太陽電池の温度上昇を防止するのに好適な太陽電池装置に関する。

【０００２】

【従来の技術】従来より、図４に示すような強制空冷システムを設けた太陽電池冷却装置Ｓ４が用いられている。この太陽電池出力回路Ｐ４は、太陽電池モジュール（以下、太陽電池）５１と、これに接触させた温度センサＴＳと、負荷Ｈや蓄電池Ｂに出力を供給するための陽極（以下、＋），陰極（以下、－）外部出力端子５３，＊

$$P_m(t)=P_m(L/1000)(1+a(t-25)) \quad \cdots \quad (1)$$

ここで、

$P_m(t)$；太陽電池の温度が t ℃の場合の最大出力 W

P_m　；標準試験条件（太陽電池の温度が25 ℃，日射強度が1000 W/m²，エアマスが1.5）での最大出力 W

L　；日射強度 W/m²

a　；温度係数 ℃⁻¹

t　；太陽電池の温度 ℃

通常、温度係数ａは-0.0051 ℃⁻¹ であるので、太陽電池の温度が25 ℃ の場合を基準に、太陽電池の温度が１ ℃ 上昇すれば、その出力は0.51 ％ 低下し、逆に１ ℃ 下降すれば、その出力は0.51 ％ 増大することになる。

【０００６】このため、従来から図４に示すように、太陽電池出力回路Ｐ４とは別に独立した強制冷却システムＣ４を設け、太陽電池５１の温度が上昇した場合にファン５７を回転させ、これにより太陽電池５１の温度を下げてその出力を増大させようとする試みがなされてきた。そして、（１）式から明らかなように、最大出力$P_m(t)$は日射強度Ｌによって大きく増減し、太陽電池５１の温度ｔも日射強度Ｌによって上昇程度が大きく左右されるので、日射強度Ｌ、温度ｔの上昇の程度、及び最大出力$P_m(t)$が小さいときに、無駄にモーター５６等が動作しないように、スイッチ５８や温度センサＴＳ等が設けられてきた。

【０００７】また、太陽電池の温度上昇は夏期の日射強度の強い場合などには、太陽電池の表面温度は６０℃以上にもなり、多結晶Ｓｉ太陽電池の場合、その変換効率は１０％以下に低下するようなことも稀ではない。そこで、この温度上昇を少しでも緩和させるために、太陽電池の裏面側に放熱フィンを設けたり、冷却風路を設けたりして放熱能力を高めるようなことが行われている。

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＊５４、と、太陽電池５１の陽極側に設けた逆流防止ダイオード５２等から構成され、太陽電池５１の近傍に強制空冷システムＣ４を設けている。

【０００３】ここで、強制空冷システムＣ４は、交流電源５５によりモーター５６を駆動せしめてファン５７を回転させて太陽電池５１を空冷するものであり、モーター５６の作動は温度センサＴＳからの出力信号に基づいて電源５５とモーター５６との間に設けたスイッチ５８を開閉することによって行う。

【０００４】太陽電池５１に強い太陽光が入射すると、一般的な太陽電池の光電変換効率は通常十数％程度でなので、入射太陽光エネルギーの大部分は熱エネルギーとなって、太陽電池５１の温度上昇をもたらす。太陽電池の温度が上昇すると、一般に太陽電池の光電変換効率は低下し、その出力も減少する。

【０００５】例えば多結晶Ｓｉ太陽電池の場合、出力特性は下記（１）式のごとくに表される。

【０００８】また、太陽電池の裏面側に水ジャケットまたは水冷管を配設し、水冷により太陽電池の温度上昇を防止するようにすることが、特に集光型の太陽電池装置においては、空冷より水冷の方が一般に冷却能力が高いために行われてきた。

【０００９】

【発明が解決しようとする課題】しかしながら、上記スイッチ５８の動作を制御する温度設定が低すぎると、夏期における外気温度が高く且つ日射強度Ｌの小さい時にモーター５６が作動し、最大出力$P_m(t)$の増大によるエネルギーゲインよりも強制冷却システムＣ４が動作するのに必要なエネルギーロスの方が大きくなるというような不都合が起こりやすかった。しかも、温度センサＴＳの配置や強制冷却システムＣ４の設置は太陽電池冷却装置Ｓ４のコストを増大させるというデメリットもあった。これらの不都合を無くすために、図５に示すように、図４におけるスイッチ５８、温度センサＴＳ、及び電源５５を小型太陽電池５９で置き換え、この空冷システムＣ４をメインの太陽電池５１の近傍に設置する方式も考えられる。ところが、小型太陽電池といっても太陽電池自体は高価であり、強制冷却システムＳ５のコスト高の原因となるし、メインの太陽電池５１に並設する必要もあり、太陽電池５１，５９の設置面積の増大をもたらすという新たな不都合も生じる。

【００１０】また、空気による放熱の場合、空気境膜の伝熱係数はあまり大きくないため、充分な放熱効果を得るためには、空気の流速を大きくさせる必要があり、これを実現させるための設備が必要となったり、太陽電池装置が大型化複雑化するといった問題が生じる。また、上述した従来の水冷システムは、特に集光型ではない太陽電池装置に適用しようとすると、広い太陽電池裏面全

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体に水冷管を張りめぐらせる必要があり、この構築が煩雑で設置コストもかかりすぎるため問題である。

【0011】そこで、本発明は従来の諸問題を解消するため、きわめて簡便な構成で、かつ太陽光エネルギーの有効活用をしながら、常に太陽電池の温度上昇を防止するように強制冷却が可能な優れた太陽電池装置を提供することを目的とする。

【0012】

【課題を解決するための手段】上記課題を解決するために、本発明の太陽電池冷却装置は、太陽電池の出力回路と、該太陽電池の温度上昇を防止する冷却手段の作動回路とを、逆流防止ダイオードを介して直列接続し、前記太陽電池の出力でもって前記作動回路を動作せしめるように成した。

【0013】

【作用】上記構成の太陽電池装置によれば、従来よりきわめて簡便かつ安価な構成であり、しかも直接太陽電池でもって日射強度に応じた作動回路の駆動が実現できるので、太陽電池の強制冷却を自動的にかつ最適に行うことができる。

【0014】特に、冷却手段が空冷装置である場合の作動回路を太陽電池に送風するファンのモーターとするか、あるいは冷却手段が水冷装置である場合の作動回路を太陽電池へ送水する（例えば太陽電池受光面に直接散水するための）電動ポンプのモーターとすることで構成がきわめて簡便となり、装置全体を小型化することができる。

【0015】また、冷却手段が太陽電池の受光面へ噴霧もしくは放水を行うための散水装置から成り、作動回路が散水装置に一定水圧が加わった給水管を接続する電動バルブの開閉に使用させるように構成すれば、水の蒸発潜熱を有効に活用することができ、従来の太陽電池裏面側における冷却構成と比較してかなり簡便となり、また、冷却水量も太陽電池の裏面の水冷に比較してきわめて少量で済む。

【0016】さらに、太陽電池受光面への散水は、受光面上の塵埃が適宜に洗い流され、受光面の洗浄をも同時におこなうことができる。さらにまた、水の屈折率は太陽電池の受光面を覆う材質と空気との中間であるので受光面上に水の膜ができると、太陽光の反射率が小さくなり太陽光入射量が増大する。

【0017】

【実施例】本発明に係る一実施例を詳細に説明する。まず、冷却手段が空冷装置の場合について説明する。図1に示すように、太陽電池装置Ｓ１は複数の太陽電池素子が直列及び／又は並列接続されて成る太陽電池モジュール（以下、太陽電池）１と、冷却手段（太陽電池１の近傍に設けた電動モーター（以下、モーター）３とファン４から成る電動ファンF）と、負荷Hや蓄電池Bに出力を供給するための＋，－外部出力端子５，６、と、太陽

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電池１の＋側に設けた逆流防止ダイオード２等から成り、太陽電池出力回路Ｐ１と作動回路とが逆流防止ダイオード２を介して直列接続されている。そしてさらに、蓄電池Ｂ及び負荷Hとの負荷側回路Ｌ１とが設けられている。ここで、モーター３は太陽電池の＋側に直列接続されており、太陽電池出力回路Ｐ１に負荷H等が接続されると太陽電池１の出力により回転する。また、太陽電池１の出力は蓄電池Bに蓄えられたり、負荷Hを作動させるようにしている。

【0018】通常、太陽電池の１素子当たりの出力電圧は小さなものであり、多結晶Ｓｉ太陽電池の場合0.6 V以下である。このため、外部負荷Hや蓄電池Bの充電に必要とされる電圧（例えば12～200V）を得るために、太陽電池１は多数の素子を直列に結線している。したがって、太陽電池１の出力電流は単位素子の出力電流と同様に数アンペア程度となり、モーター３には一方向の数アンペア程度の電流が流れる。ここで、モーター３のトルクTはモーター電流Ｉに比例するが、この電流Ｉは太陽電池１の出力電流でもあるので日射強度Lに比例し、トルクTは日射強度Lに比例して増減することになる。すなわち，日射強度Lが大きく太陽電池１の温度上昇が大きい場合には、電動ファンFの駆動力が大きくなり、日射強度Lが小さい場合には自動的に電動ファンFの駆動力も小さくなり過剰な冷却が防止されるのである。

【0019】ただし、電動ファンFを起動するのに最低限必要な起動トルク以下に相当する電流以下の小さな太陽電池出力電流の場合、ファンを回転させることが不可能となり、この電流が無駄に消費されることになるので、なるべく起動トルクの小さなモーターを選択するとよい。

【0020】通常、モーターは過負荷、過印加電圧などによって電流が過大となると、発熱によりモーター巻線の焼損、磁石の消磁などの問題を引き起こすが、この実施例では電流は太陽電池１で発電された出力電流以上にはならないので、モーターを適当に選択すればこのような心配は不要である。

【0021】太陽電池の温度上昇による出力低下は、北緯３５° 付近（例えば京都）では通常の固定架設置の場合、冬期で１０％程度、夏期で２０％程度が低下度合の最大となる。このため、これを上記冷却手段で強制冷却する場合に、使用するモーターはその消費電力がこれらの最大値を少なくとも上回らないものを選定する必要がある。この目安としてモーターの定格出力が標準太陽電池出力の約5 ％以下のものを使用すれば、ほぼこの目的を達成することができる。

【0022】すなわち、例えば出力Pm ＝34 V ×3 A ＝102 W の太陽電池 3枚を直列に電気結線した太陽光発電システムに、定格出力4.5 W のモーター（標準太陽電池出力の約1.5 ％）を設けた電動ファンを用いれば、年間約4.5 ％の太陽光発電電力量の増加を見込むことがで

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きる。

【００２３】また、このようなモーターの使用法をとると、かなり広いトルク領域にわたって回転数が低下しないので、モーターの効率はファン起動トルク電流以上の大部分のモーター電流域で50％以上の高い効率を維持できるが、モーターの定格出力が標準太陽電池出力の 5％以上になると、モーターで消費する電力が標準太陽電池出力の10％以上になることが多くなり、太陽電池の温度低下で得られるエネルギーゲインを上回ることが多い。

【００２４】なお、太陽電池１と作動回路とを逆流防止ダイオードを介して直列接続されていればよく、上述の実施例のように必ずしも＋側外部出力端子５と太陽電池１との間に作動回路が無くともよい。また、モーターの多数を並列接続してもよく、この場合には各モーターの定格電圧時の停動電流値の合計が太陽電池１の短絡電流程度とするとよい。

【００２５】次に、冷却手段が散水装置である場合について説明する。すなわち、冷却手段が太陽電池の受光面へ噴霧もしくは放水を行うための散水装置から成り、冷却手段の作動回路として散水装置に一定水圧が加わった給水管を接続する電動バルブの開閉に使用させるべく構成したもの（例えば電磁バルブ等の回路）について説明する。図２に示すように、ガラスで覆われた受光面の大きさ約７ｍ　×3.6 ｍ、出力約3ｋ　Ｗ　の太陽電池１１が家屋の屋根ＲＦに設置されており、この太陽電池１１の上辺に沿って、約10㎜径の散水装置である散水管１２を配設している。この散水管１２の側部の両端から１４５０㎜の長さには、それぞれ約１㎜径の散水孔１２ａが７０㎜間隔で２１個設けられ、胴体部の約４２００㎜に渡る長さには0.7 ㎜径の散水孔１２ｂが７０㎜間隔で５９個設けられている。このように孔径や孔の間隔を設定することにより、すなわち給水管に近い箇所は小さい孔、遠い箇所はより大きい孔とすることで、水をできるだけ均一に放出することが可能となる。また、この散水管１２のほぼ中央部には給水管１３が設けられており、この給水管１３には電動バルブ１４が設けられ、この図１のごとくモーターの代わりに電動バルブ１４の開閉手段が設けられ、太陽電池１１と開閉手段と逆流防止ダイオードとが直列接続されている。なお、この電動バルブ１４は水道栓１５と散水管１２との間であればどこに設けられていてもよい。

【００２６】なお、電動バルブ１４の開閉手段は太陽電池１１の裏面側に接着した温度センサ１６と電気的に接続されており、これによる検出温度がある設定値以上、例えば50℃以上になると、電動バルブ１４に設けたタイマーを駆動させ0.5 分間開、4.5 分間閉の動作、すなわち、5 分間に1 回、約30秒間の間歇水供給を行うような動作をするようにする。この実施例では間歇水供給を約2.5 リットル／回に調整することによって、太陽電池モジュールの平均温度をこの水散布冷却を行わない場合より約10℃以上下降させることができた。

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【００２７】この実施例においては、太陽電池裏面に水冷や空冷をする場合と比較して、太陽電池の側辺から水冷する簡便な構成で済む。また、空気より水の境膜伝熱係数は1 オーダ以上大きいため、放熱能力が非常に大きくなる。また、受光面側に水を散布もしくは噴霧することによって、水の蒸発潜熱を有効に活用することができ、必要水量も非常に少なくともよい。また、散水により受光面上の塵埃等が洗い流されるうえ、水の屈折率が表面のガラス面と空気の中間の値であるため、太陽電池の受光面での太陽光反射率が小さくなるなど利点を有する。

【００２８】なお、この実施例においては水供給源として単純に水道栓付の水道を利用する例について示したが、電動モーターを具備したポンプ付の水道や井戸等を利用してもよく、電動バルブの他に電動モーターを具備した加圧ポンプを設けたものとしてもよく、これら作動回路を太陽電池と逆流防止ダイオードとに直列接続するように構成してもよい。また、水を散布する手段も上述の例に限定されるものではなく、スプリンクラー、じょうろタイプ、噴水タイプ、噴霧タイプなど、太陽電池の受光面側の広い範囲にわたって水を散布できるものであれば種々のバリエーションを適用することができる。

【００２９】また、間歇水供給の供給時間、インターバル時間、一回当たりの供給水量などは、太陽電池の設置状態や電動バルブの動作設定温度等によって大きく変化するものであるから、上記した数値に限定されるものではなく、本発明の要旨を逸脱しない範囲内で適宜変更実施が可能である。また、上記作動回路として太陽電池へ送水を行う電動モータを備えた電動ポンプを用い、電動ポンプに給水管を接続することによって、電動ポンプから適宜に太陽電池の受光面等へ散水を行うものを用いても上記実施例と同様な作用・効果を奏することが可能である。

【００３０】

【発明の効果】以上のように、本発明によれば、従来よりきわめて簡便かつ安価な構成を採用することができ、しかも日射強度に応じて作動回路を動作できるので、太陽電池の強制冷却を自動的にかつ最適に行うことができる。特に、作動回路を太陽電池に送風するファンのモーターとすることで構成がきわめて簡便となり、装置全体を小型化とすることができる。

【００３１】また、太陽電池の受光面へ噴霧もしくは放水を行うための散水装置を配設するとともに、作動回路を散水装置に給水するための手段とすることは、太陽電池の受光面を水冷するので、従来の太陽電池の裏面側を冷却する構成と比較してきわめて簡便となり、また、水冷により水の蒸発潜熱を有効に活用することができるので、冷却水量も太陽電池の裏面の水冷に比較してきわめて少量で済む。

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【００３２】さらに、太陽電池の受光面を水冷する場合、噴霧もしくは放水により塵埃が適宜に洗い流され、太陽電池の温度上昇を防止するとともに、受光面の洗浄をも同時におこなうことができる。さらにまた、水の屈折率は太陽電池の受光面を覆う材質と空気との中間であるので受光面上に水の膜ができると、太陽光の反射率が小さくなり、太陽光入射量が増大するので、従来より効率の優れた太陽電池装置を提供できる。

【図面の簡単な説明】

【図１】本発明に係る一実施例を示す回路構成図である。

【図２】本発明に係る他の実施例を示す概略構成図である。

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【図３】散水管の拡大図である。

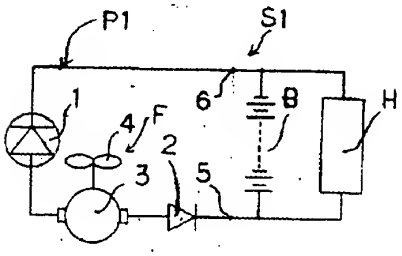
【図４】従来例を示す回路構成図である。

【図５】他の従来例を示す回路構成図である。

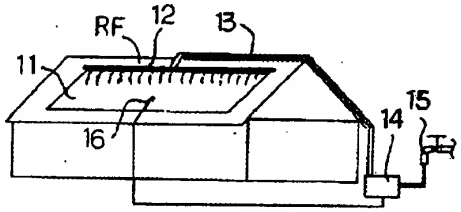
【符号の説明】

１，１１　・・・　太陽電池
２　・・・　逆流防止ダイオード
３　・・・　モーター
１２　・・・　散水管
１３　・・・　給水管
１４　・・・　電動バルブ
Ｓ１・・・　太陽電池装置

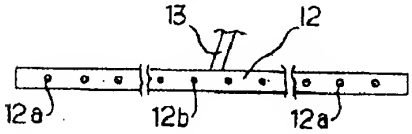
【図１】



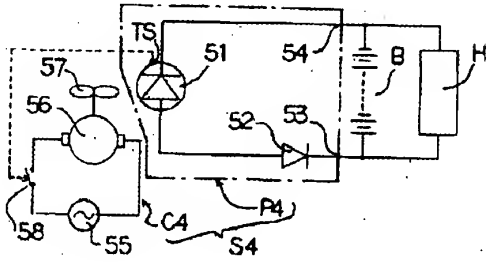
【図２】



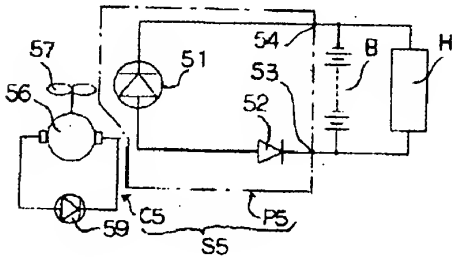
【図３】



【図４】



【図５】



PATENT ABSTRACTS OF JAPAN

(11)Publication number : 07-240532

(43)Date of publication of application : 12.09.1995

(51)Int.Cl. H01L 31/042
H01L 31/04

(21)Application number : 06-030297

(22)Date of filing : 28.02.1994

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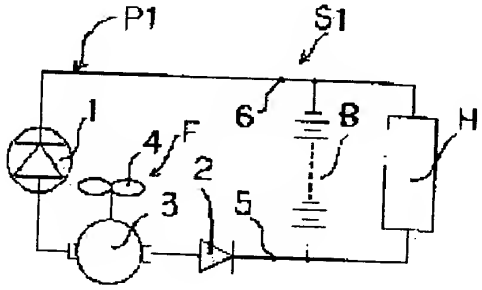
(54) SOLAR CELL DEVICE

(57)Abstract:

PURPOSE: To provide an excellent solar cell device which is simple in structure and forcibly cooled down constantly utilizing solar energy so as not to rise in temperature.

CONSTITUTION: The output circuit of a solar cell 1 and a drive circuit 3 which actuates a cooling means 4 that restrains the solar cell 1 from rising in temperature are connected in series through the intermediary of a reverse current check diode 2, wherein the drive circuit 3 is actuated by the output of the solar cell 1 to drive the cooling means.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] this invention relates to suitable solar-battery equipment to prevent the temperature rise of a solar battery using operation circuits, such as a fan and a bulb.
[0002]
[Description of the Prior Art] Solar-battery cooling-system S4 which formed the forced-air-cooling system as shown in drawing 4 conventionally is used. This solar-battery output circuit P4 consisted of antisuckback diode 52 grades prepared in the solar cell module (following, solar battery) 51, temperature sensor [which was contacted to this] TS, anode plate [for supplying an output to a load H and Battery B] (following, +) and cathode (following, -) external output terminals 53 and 54, and anode plate side of a solar battery 51, and has formed the forced-air-cooling system C4 near the solar battery 51.
[0003] Here, the forced-air-cooling system C4 makes a motor 56 drive by AC power supply 55, rotates a fan 57, carries out air cooling of the solar battery 51, and performs the operation of a motor 56 by opening and closing the switch 58 formed between the power supply 55 and the motor 56 based on the output signal from a temperature sensor TS.
[0004] Since the photoelectric conversion efficiency of a general solar battery is usually at about about ten% when sunlight strong against a solar battery 51 carries out incidence, the great portion of incidence sunlight energy turns into heat energy, and it brings about the temperature rise of a solar battery 51. If the temperature of a solar battery rises, generally, the photoelectric conversion efficiency of a solar battery will fall and the output will also decrease.
[0005] For example, in the case of a polycrystal Si solar battery, output characteristics are expressed like following the (1) formula.
Pm(t) =Pm (L/1000) (1+a) (t-25) ... (1)
Here, it is Pm (t). ; The maximum output in case the temperature of a solar battery is t ** WPm ; Standard test condition (for 25 ** and solar radiation intensity, 1000 W/m2 and an air mass are [the temperature of a solar battery] 1.5) Maximum output WL ; Solar radiation intensity W/m2a ; Temperature coefficient **-1t ; temperature [of a solar battery] ** -- usually -- a temperature coefficient a -0.0051 **-1 it is -- since -- The temperature of a solar battery on the basis of the case where the temperature of a solar battery is 25 ** If 1 ** elevation of is done, the 0.51 % fall of the output will be done, and it is conversely. If 1 ** descent of is done, 0.51 % increase of the output will be done.
[0006] For this reason, as shown in drawing 4 from the former, when the forced-cooling system C4 which became independent apart from the solar-battery output circuit P4 was formed and the temperature of a solar battery 51 rose, the fan 57 was rotated, and the attempt which the temperature of a solar battery 51 tends to be lowered [attempt] by this, and is going to increase the output has been made. And the maximum output Pm (t) was greatly fluctuated with the solar radiation intensity L, and since a rise grade is greatly influenced for the temperature t of a solar battery 51 by the solar radiation intensity L, a switch 58, a temperature sensor TS, etc. are provided so that motor 56 grade may not operate [the grade of a rise of the solar radiation intensity L and temperature t, and the maximum output Pm (t)] vainly, when small so that clearly from (1) formula.
[0007] Moreover, when the solar radiation intensity of a summer of the temperature rise of a solar battery

is strong, the skin temperature of a solar battery becomes 60 degrees C or more, and, in the case of a polycrystal Si solar battery, what falls to 10% or less is not rare [the conversion efficiency]. Then, in order to make this temperature rise ease, what a radiation fin is prepared, or a cooling air course is prepared, and raises heat dissipation capacity to the rear-face side of a solar battery is performed.
[0008] Moreover, a water jacket or the water-cooled tube was arranged in the rear-face side of a solar battery, and especially, in condensed type solar-battery equipment, for the water cooling, since refrigeration capacity is high, generally, preventing the temperature rise of a solar battery with water cooling has been performed from air cooling.
[0009]
[Problem(s) to be Solved by the Invention] However, when a temperature setup which controls operation of the above-mentioned switch 58 is too low and the solar radiation intensity L has [the OAT in a summer is high and] it, a motor 56 operates, and it tended to happen un-arranging [that the direction of an energy loss more nearly required than the energy gain by increase of the maximum output Pm (t) for the forced-cooling system C4 to operate becomes large]. [small] And arrangement of a temperature sensor TS and installation of the forced-cooling system C4 also had the demerit of increasing the cost of the solar-battery cooling system S4. In order to lose these un-arranging, as shown in drawing 5 , the switch 58 in drawing 4 , a temperature sensor TS, and a power supply 55 are replaced by the small solar battery 59, and the method which installs this air-cooling system C4 near the main solar batteries 51 is also considered. However, even if it calls it a small solar battery, the solar battery itself is expensive, and it is necessary to become the cause of the cost quantity of the forced-cooling system S5, and to install in the main solar batteries 51 side by side, and also produces new un-arranging [of bringing about increase of the installation area of solar batteries 51 and 59].
[0010] moreover, since the heat transfer coefficient of an air laminar film is not not much large, in order to acquire sufficient heat dissipation effect in heat dissipation with air, it is necessary to enlarge the rate of flow of air, and the facility for making this realize is needed, or enlargement complication, then the said problem arise [solar-battery equipment] Moreover, when it is going to apply to the solar-battery equipment which is not a condensed type, it needs to spread the water-cooled tube around the large whole solar-battery rear face, this construction of especially the conventional water-cooled system mentioned above is complicated, and in order for installation cost to also start too much, it is a problem.
[0011] Then, in order that this invention may solve many conventional problems, it is very simple composition, and it aims at offering the outstanding solar-battery equipment in which forced cooling is possible so that the temperature rise of a solar battery may always be prevented, using sunlight energy effectively.
[0012]
[Means for Solving the Problem] In order to solve the above-mentioned technical problem, the solar-battery cooling system of this invention carried out the series connection of the output circuit of a solar battery, and the operation circuit of a cooling means to prevent the temperature rise of this solar battery, through antisuckback diode, had them with the output of the aforementioned solar battery, and it accomplished them so that the aforementioned operation circuit might be made to operate.
[0013]
[Function] According to the solar-battery equipment of the above-mentioned composition, it is composition very simpler than before and cheap, and since it moreover has by the direct solar battery and the drive of an operation circuit according to solar radiation intensity can be realized, forced cooling of a solar battery can be performed automatically and the optimal.
[0014] Especially, an operation circuit in case a cooling means is an air-cooling device is used as the motor of the fan who ventilates a solar battery, or composition becomes very simple by using an operation circuit in case a cooling means is a water cooler as the motor of an electric rotary pump (for example, in order to water a solar-battery light-receiving side directly) which supplies water to a solar battery, and the whole equipment can be miniaturized.
[0015] Moreover, it consists of the sprinkler system for a cooling means performing spraying or water-drainage to the light-receiving side of a solar battery, if it constitutes so that it may be made to use it for the opening and closing of an electric bulb whose operation circuit connects the feed pipe with which fixed water pressure joined the sprinkler system, the latent heat of vaporization of water can be utilized

effectively, and it will become quite simple as compared with the cooling composition by the side of the conventional solar-battery rear face, and a circulating water flow is also very little as compared with water cooling of the rear face of a solar battery, and ends.
[0016] Furthermore, the dust on a light-receiving side is flushed suitably, and, as for the water spray to a solar-battery light-receiving side, washing of a light-receiving side can also be performed simultaneously. Since it is the middle of the wrap quality of the material and air, if the light-receiving side of a solar battery is made by the film of water on a light-receiving side, the reflection factor of sunlight will become small and, as for the refractive index of water, the amount of sunlight incidence will increase further again.
[0017]
[Example] One example concerning this invention is explained in detail. First, the case where a cooling means is an air-cooling device is explained. As shown in drawing 1 , two or more solar battery elements solar-battery equipment S1 A serial and/or the solar cell module 1 which parallel connection is carried out and changes (the following, solar battery), A cooling means (the electrical motor (the following, motor) 3 prepared near the solar battery 1, and the electric fan F who consists of a fan 4), It consists of the antisuckback diode 2 grade prepared in + side of a solar battery 1, and the series connection of the solar-battery output circuit P1 and the operation circuit is carried out to + for supplying an output to a load H and Battery B, and the - external output terminals 5 and 6 through the antisuckback diode 2. And Battery B and the load side circuit L1 with a load H are formed further. Here, the series connection of the motor 3 is carried out to + side of a solar battery, and if a load H etc. is connected to the solar-battery output circuit P1, it will rotate by the output of a solar battery 1. Moreover, the output of a solar battery 1 is stored in Battery B, or it is made to operate a load H.
[0018] Usually, the output voltage per element of a solar battery is small, and, in the case of a polycrystal Si solar battery, is below 0.6 V. For this reason, voltage needed for charge of the external load H and Battery B (for example, 12-200V) In order to obtain, the solar battery 1 is connecting many elements in series. Therefore, the output current of a solar battery 1 becomes about several A like a unit element child's output current, and, on the other hand, Mukai's about several A current flows on a motor 3. Here, although the torque T of a motor 3 is proportional to motor current I, since this current I is also the output current of a solar battery 1, it will be proportional to the solar radiation intensity L, and will fluctuate Torque T in proportion to the solar radiation intensity L. That is, when [large] the temperature rise of a solar battery 1 is large, the electric fan's F driving force becomes [the solar radiation intensity L] large, the electric fan's F driving force also becomes [the solar radiation intensity L] small automatically [when small], and superfluous cooling is prevented.
[0019] However, since it becomes impossible in the case of the small solar-battery output current below the current equivalent to below a starting torque indispensable to start the electric fan F to rotate a fan and this current will be consumed vainly, it is good to choose a motor with a starting torque small if possible.
[0020] Usually, since current will not become in this example more than the output current generated by the solar battery 1 although generation of heat causes problems, such as burning of motor winding, and magnetic demagnetization, if a motor becomes excessive [current] with overload, fault applied voltage, etc., such worries are unnecessary if a motor is chosen suitably.
[0021] In the usual cover-half installation near north latitude 35 degree (for example, Kyoto), in a summer, about 20% serves as about 10% in winter, and the loss of power by the temperature rise of a solar battery serves as the maximum of a fall degree. For this reason, when carrying out forced cooling of this with the above-mentioned cooling means, the motor to be used needs to select that to which the power consumption does not exceed such maximums at least. If the rated output of a motor uses the following [abbreviation 5 % of a standard solar-battery output] as this standard, this purpose can be attained mostly.
[0022] Namely, for example, output Pm =34 V x3 A =102 W Solar battery To the photovoltaics system which carried out the electric connection of the three sheets in series, it is rated output 4.5 W. Motor (about 1.5 % of a standard solar-battery output) If the electric fan who prepared is used, the increase in the photovoltaics electric energy of annual about 4.5 % can be expected.
[0023] Moreover, although the efficiency of a motor can maintain 50% or more of high efficiency in the motor current region beyond [the great portion of] fan starting-torque current since a rotational

frequency does not fall over a quite large torque field if the usage of such a motor is taken The rated output of a motor is a standard solar-battery output. If it becomes 5% or more, the bird clapper of power consumed by the motor will increase in 10% or more of a standard solar-battery output, and it will exceed the energy gain acquired by the temperature fall of a solar battery in many cases.

[0024] in addition -- there is not necessarily no operation circuit between + side external output terminal 5 and a solar battery 1 like an above-mentioned example that what is necessary is just to carry out the series connection of a solar battery 1 and the operation circuit through antisuckback diode -- ** -- it is good Moreover, it is good to carry out parallel connection of many motors, and for the sum total of the **** current value at the time of the rated voltage of each motor to consider as the short-circuit current grade of a solar battery 1 in this case.

[0025] Next, the case where a cooling means is a sprinkler system is explained. That is, it consists of the sprinkler system for a cooling means performing spraying or water-drainage to the light-receiving side of a solar battery, and what was constituted to make it use it for opening and closing of the electric bulb which connects the feed pipe with which fixed water pressure joined the sprinkler system as an operation circuit of a cooling means (for example, circuits, such as an electro-magnetic valve) is explained. Size abbreviation of the light-receiving side which was being worn with glass as shown in drawing 2 7 m x3.6 m, output about 3k W The solar battery 11 is installed in the roof RF of a house, and the water spray pipe 12 which is the sprinkler system of the diameter of about 10mm is arranged along with the surface of this solar battery 11. Powder hydrospore 12a of the diameter of about 1mm is prepared in a length of 1450mm at intervals of [21] 70mm from the ends of the flank of this water spray pipe 12, respectively, and powder hydrospore 12b of the diameter of 0.7 mm is prepared in the length over about 4200mm of the fuselage section at intervals of [59] 70mm. Thus, it is considering as a hole with the small part near setting up the interval of an aperture or a hole, i.e., a feed pipe, and a hole with a distant larger part, and it becomes possible to emit water as uniformly as possible. Moreover, the feed pipe 13 is mostly formed in the center section, the electric bulb 14 is formed in this feed pipe 13, the opening-and-closing means of the electric bulb 14 is established instead of [of this water spray pipe 12] being a motor like this drawing 1 , and the series connection of a solar battery 11, an opening-and-closing means, and the antisuckback diode is carried out. In addition, as long as this electric bulb 14 is between the water service plug 15 and the water spray pipe 12, it may be prepared anywhere.

[0026] In addition, if the opening-and-closing means of the electric bulb 14 becomes more than the more than set point, for example, 50 degrees C, that is electrically connected with the temperature sensor 16 pasted up on the rear-face side of a solar battery 11, and has the detection temperature by this the timer formed in the electric bulb 14 is driven -- making -- 0.5 a part -- between -- open -- 4.5 a part -- between -- close -- operation, 5 [i.e.,], a part -- between -- one It is made to carry out operation which performs a time and intermittent water supply for about 30 seconds. At this example, it is intermittent water supply About 2.5 By adjusting to a liter/time, the mean temperature of a solar cell module was able to be dropped by about 10 degrees C or more from the case where this hydrochory cooling is not performed.

[0027] In this example, it ends with the simple composition which carries out water cooling from the side side of a solar battery as compared with the case where water cooling and air cooling are made a solar-battery rear face. Moreover, the film coefficient of heat-transfer of water is 1 from air. More than order, since it is large, thermolysis capacity becomes very large. Moreover, by sprinkling or spraying water on a light-receiving side side, the latent heat of vaporization of water can be utilized effectively, and water requirement is also good very at least. Moreover, in the dust on a light-receiving side etc. being flushed by water spray, since the refractive indexes of water are the glass side of a front face, and the middle value of air, it has an advantage -- the sunlight reflection factor in respect of light-receiving of a solar battery becomes small.

[0028] In addition, although the example which uses water service with a water service plug simply as a water source of supply in this example was shown, water service, a well, etc. possessing the electrical motor with a pump may be used, it is good also as what prepared the booster pump possessing the electrical motor other than an electric bulb, and you may constitute so that the series connection of these operation circuit may be carried out to a solar battery and antisuckback diode. moreover, the thing by which a means to sprinkle water is also limited to an above-mentioned example -- it is not -- a sprinkler and a watering pot -- various variations are applicable if water can be sprinkled over the large range by

the side of the light-receiving side of solar batteries, such as a type, a fountain type, and a spraying type
[0029] Moreover, since the supply time of intermittent water supply, interval time, the amount of feedwaters per time, etc. change with the installation state of a solar battery, the setting temperature of an electric bulb of operation, etc. a lot, change implementation is possible for them suitably within limits which are not limited to the above-mentioned numeric value and do not deviate from the summary of this invention. Moreover, by connecting a feed pipe to an electric rotary pump using the electric rotary pump equipped with the electrical motor which supplies water to a solar battery as the above-mentioned operation circuit, even if it uses what waters from an electric rotary pump to the light-receiving side of a solar battery etc. suitably, it is possible to do so the same operation and effect as the above-mentioned example.
[0030]
[Effect of the Invention] As mentioned above, since according to this invention composition very simpler than before and cheap can be adopted and an operation circuit can moreover be operated according to solar radiation intensity, forced cooling of a solar battery can be performed automatically and the optimal. Composition becomes very simple by using an operation circuit as the motor of the fan who ventilates a solar battery especially, and the whole equipment can be considered as a miniaturization.
[0031] Moreover, the thing for which an operation circuit is made into the means for supplying water to a sprinkler system while arranging the sprinkler system for performing spraying or water-drainage to the light-receiving side of a solar battery Since it becomes very simple as compared with the composition which cools the rear-face side of the conventional solar battery since water cooling of the light-receiving side of a solar battery is carried out and the latent heat of vaporization of water can be effectively utilized with water cooling, a circulating water flow is also very little as compared with water cooling of the rear face of a solar battery, and ends.
[0032] Furthermore, when carrying out water cooling of the light-receiving side of a solar battery, while dust is suitably flushed by spraying or water-drainage and preventing the temperature rise of a solar battery, washing of a light-receiving side can also be performed simultaneously. Since it is the middle of the wrap quality of the material and air, if the light-receiving side of a solar battery is made by the film of water on a light-receiving side, since the reflection factor of sunlight will become small and the amount of sunlight incidence will increase, the refractive index of water can offer the solar-battery equipment which was excellent in efficiency conventionally further again.

[Translation done.]